



Presented to:
NREL: Thin Film Module Reliability Workshop
June 23, 2004

United Solar Ovonic Manufacturing

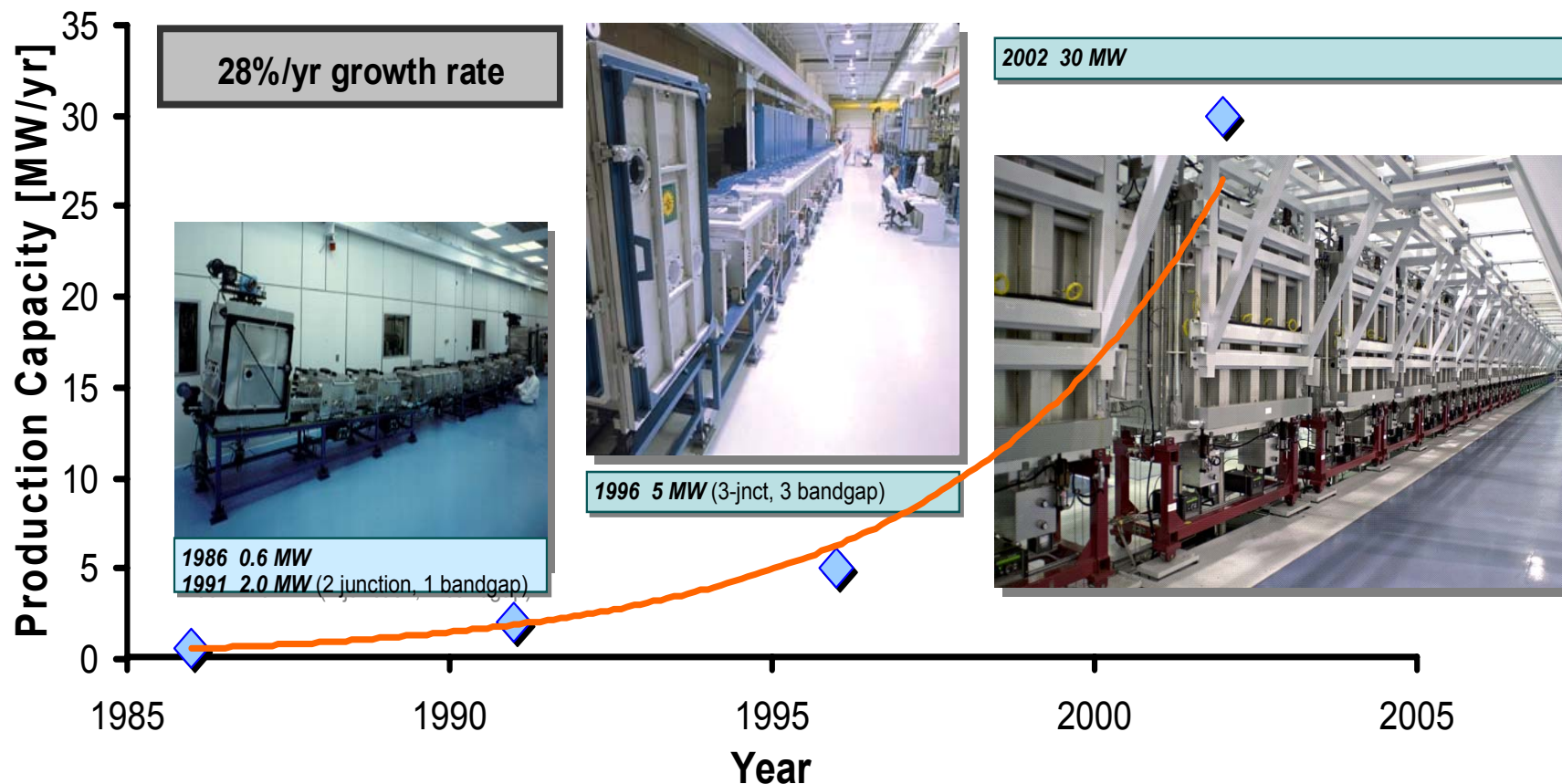
30 MW Plant

- Located in Auburn Hills, Michigan in a 167,000 sq. ft. facility
- Goal: 30 MW annual capacity with stable 8.5%+ efficiency
- Same basic processing steps but more automation including assembly
- Several improvements to improve performance (efficiency, throughput, downtime)
- Shipment from March 2003

Corporate Sales and Marketing Office:
3800 Lapeer Rd.
Auburn Hills, MI 48326
(800) 843-3892
(248) 475-0100



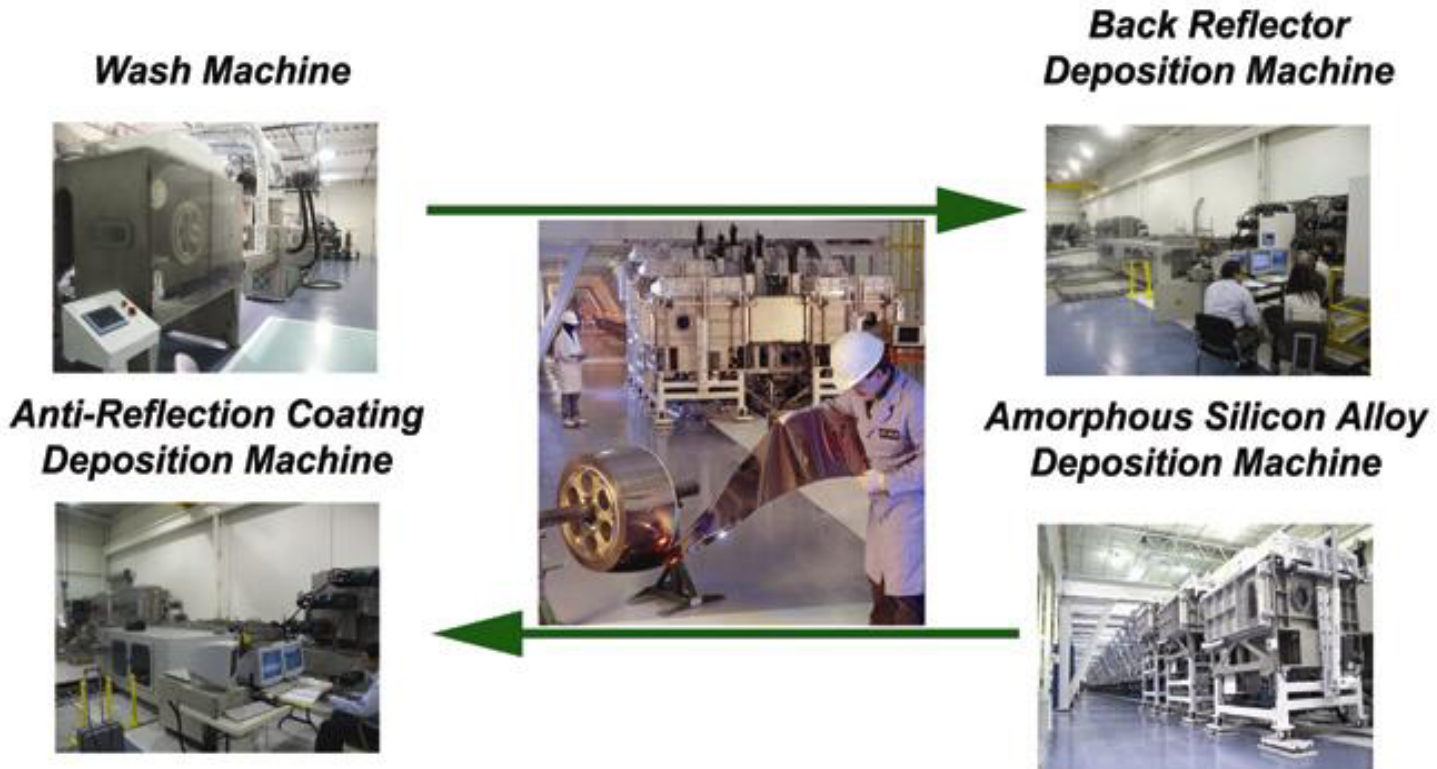
Company Expansion



ECD/United Solar Joint Venture manufacturing capacity over the last 15 years. During this time capacity has expanded at about 30%/year, with more rapid expansion in the last 5 years.

United Solar Ovonic Deposition Operation

UNI-SOLAR®
United Solar Ovonic



Schematic flowchart of the roll-to-roll deposition operation

United Solar Ovonic Deposition Operation

**Cutting of Slabs
and Coupons**



**Short Passivation
and Cell Definition**

**Bonding of
Electrodes**

Cutting of Cells

**Cell
Interconnection**



Test & Ship



Framing & Finishing



Lamination



Schematic diagram of the module assembly operation

United Solar Ovonic Sales

- ✓ 80% increase in sales between FY03 and FY04
- ✓ Greater increase in sales projected for FY04 – FY05
- ✓ Alliances:

OEM

Solar Integrated Technologies (SIT)
Alwitra
Corus
Thyssen-Krupp Hoesch Bausysteme
Chevron Energy Solutions
Sarnafil

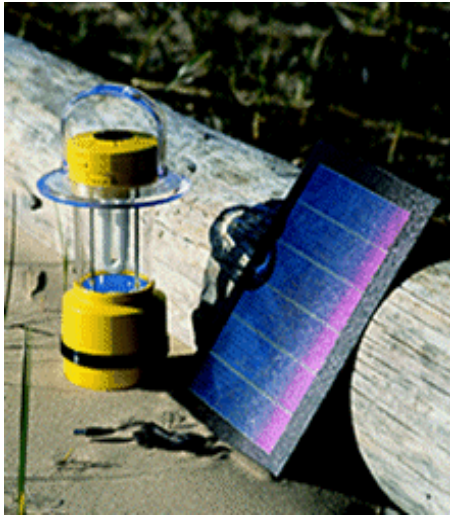
Distributors

Sunset
Donauer
Sunwize
Kyocera Solar Inc.
12 Volt Shop
AEC
Conergy



UNI-SOLAR Applications

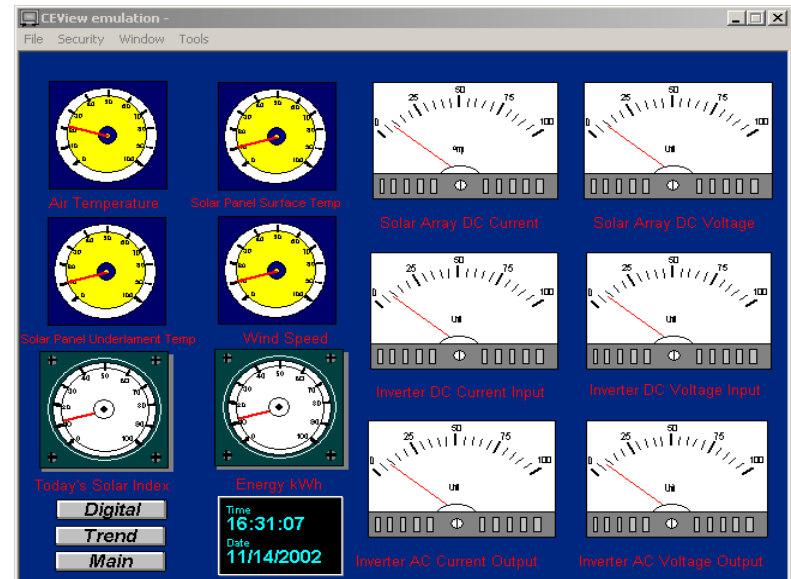
UNI-SOLAR®
United Solar Ovonic



What We Offer To The Market

United Solar Ovonic offers:

1. A portfolio of standard **UNI-SOLAR®** system design solutions for all commercial roof types
 - Low-slope, Flat Roof (Membrane, Modified Bitumen, BUR)
 - Shade structures
 - Architectural Roof (sloped standing seam metal)
2. Complete Solutions
3. Data Acquisition Systems
4. Engineering support services for new construction and/or retro-fit applications



Building Integrated PV Solutions

- PV Panels conform to roof architecture
- No roof penetrations
- No need for mounting structures
- Rapid installation
- No access limitations
- Aesthetically pleasing



Value Proposition for Commercial and Industrial Customers

PV Laminate Systems for Single Ply Roofing Membranes

✓ **UNI-SOLAR®** products are easier to install on commercial building's requiring fewer man-hours for installation.



Value Proposition for Commercial and Industrial Customers

PV Laminate Systems for Single Ply Roofing Membranes

- ✓ **UNI-SOLAR®** products are **flexible and low weight** (less than 1 lbs/sq ft) compared to more than 5 lbs/sq ft for the competition



Architectural Steel Roof and Shade Structure Solutions

UNI-SOLAR®
United Solar Ovonic

UNI-SOLAR® products conform to the shape of any UL listed metal roofing system and are easy to install



**Easily Installation with
MC® “Quick Connect”
Terminals**



How do we Ensure Reliability?

1. In-house testing of stability using both indoor and outdoor measurements
2. In-house reliability tests in accordance with IEEE 1262 and IECEC 61646
3. Outside stability data from recognized institutions
4. Outside testing by Arizona State University, Underwriters Laboratory, ISPRA and TUV

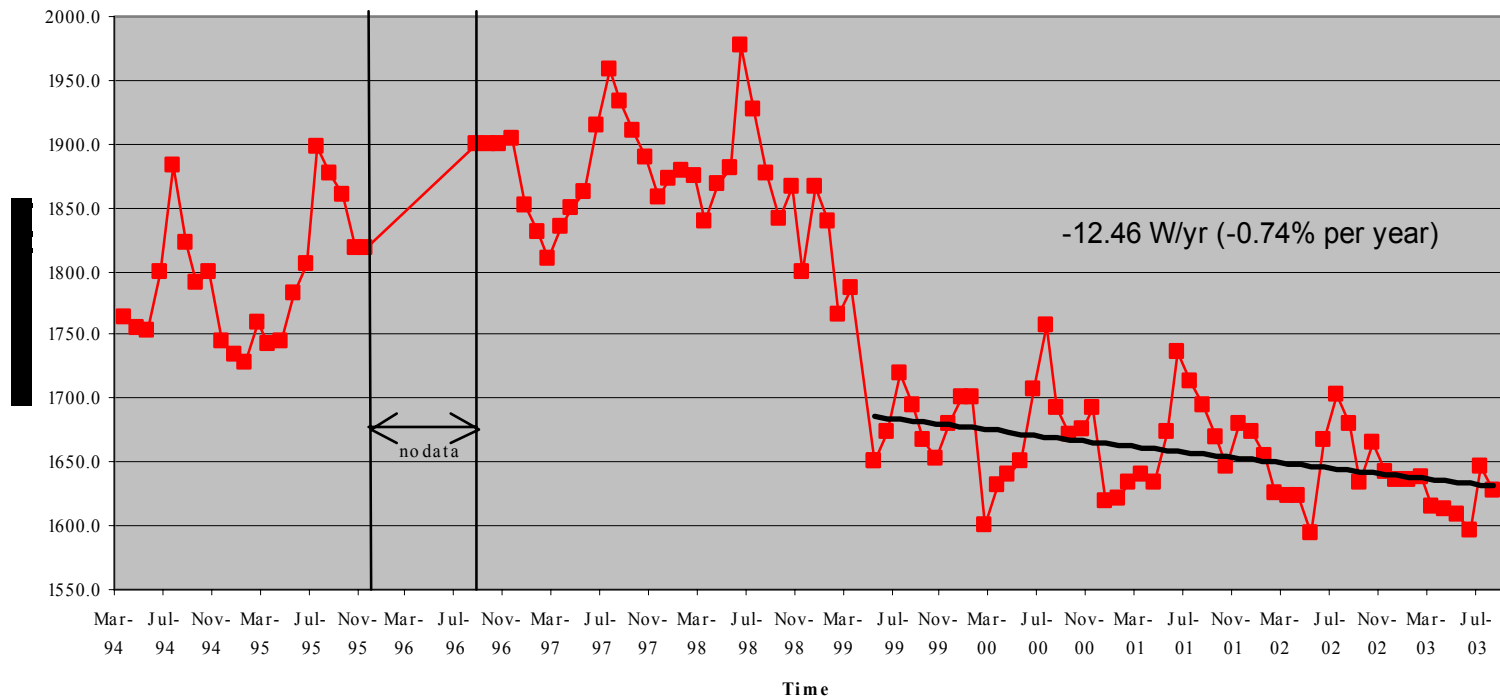
Certifications

1. Underwriters Laboratory
2. TUV
3. Factory Mutual
4. Power Mark
5. ISPRA
6. Solar Energy Center, India
7. Mexico Renewable Energy Center

NOTE: (some of these agencies also carry out factory inspection)

NREL Long-Term Degradation Testing

USSC 1.8 kW Array
PVUSA Power Rating vs Time (Irr > 800 W/m² and P > 1500W)

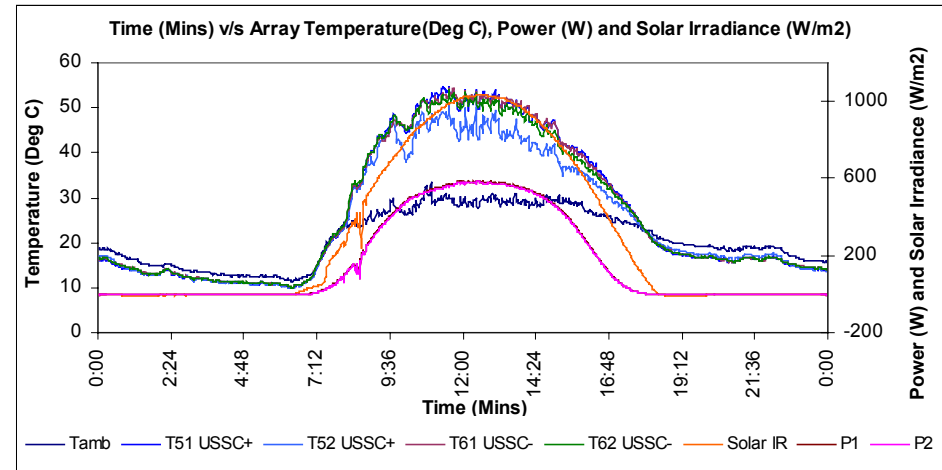
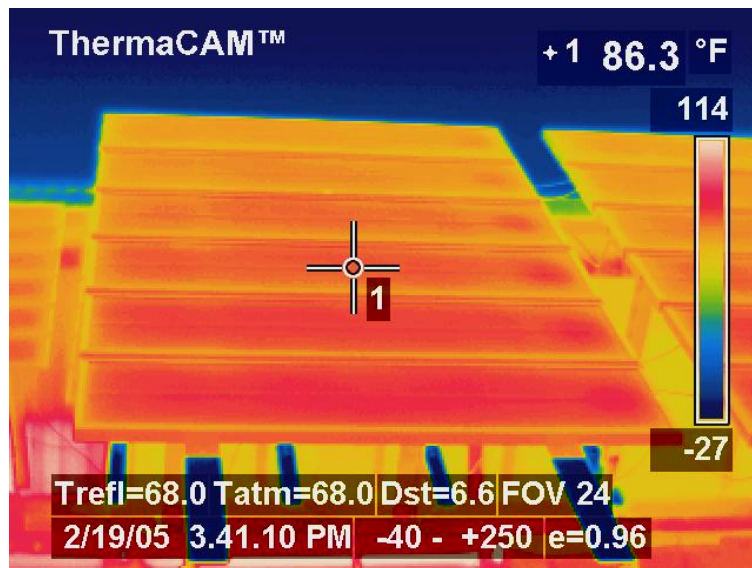


FSEC Long Term Thin Film Module Testing in Hot and Humid Climates

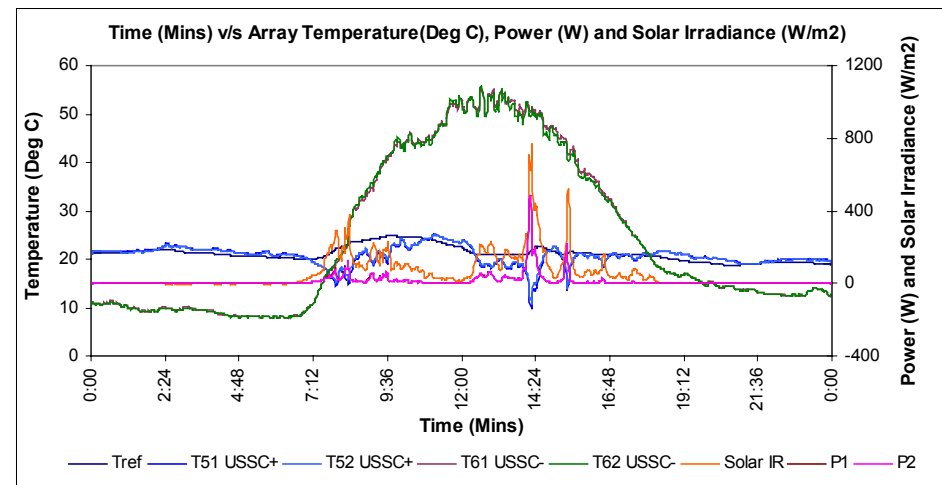
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Clear Day

First Quarter 2004 data recently submitted to United Solar Ovonic



Cloudy Day



UNI-SOLAR Modules Approved for 1000 VDC Applications (TUV)

UNI-SOLAR®
United Solar Ovonic



Certificate

Report No.: 21202411-1

License Holder: United Solar Ovonic Corp 3800 Lapeer Road Auburn Hills MI 48326 USA	Product: PV Modules Type: UNI-SOLAR® SSR-64 B/T ES 62 US-32 SSR-128 B/T ES124 US-42 SSR-192B/T ES136 US-64 SSR-256 B/T US-116
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Basis:

☒ TÜV Spec TZE/2.572.09
*Safety Class II Test on
Photovoltaic (PV) Modules*

Future Directions

1. Make the 30 MW plant capacity limited so as to build the next machine
2. Reduce production cost by improving efficiency, using alternative materials in module fabrication and increasing throughput
3. Further exploration of microcrystalline material